Assessment Information Systems

For the Forest and Rangeland 2003 Assessment, the Fire and Resource Assessment Program (FRAP) uses many information sources to describe current conditions and predict future trends. In addition to a wide variety of reports and databases, the detailed Statewide spatial information depends on several Geographic Information System (GIS) data sources. The main sources reports, databases, and GIS include:

- habitat data: Forest and Range 2003 Assessment (FRAP Multi-Source Vegetation);
- Forest Inventory and Analysis (FIA), U.S. Forest Service (USFS), Pacific Northwest Experiment Station (PNW);
- California Land Cover Mapping and Monitoring Program (LCMMP);
- fire-related data;
- census and projected development;
- The Management Landscape; and
- other GIS layers available through the California Spatial Information Library.

These programs and data products provide information that can be used in a GIS to perform summary analysis, overlay analysis, and modeling.

Habitat data: Forest and Range 2003 Assessment

For the Forest and Range 2003 Assessment, FRAP has combined habitat distribution data from the LCMMP with numerous other data sources to generate a Statewide, GIS-based data set of habitat types. FRAP classified California's habitat types using the California Wildlife Habitat Relationship (CWHR) system. The resultant data, called FRAP Multi-Source Vegetation, or FRAPVeg, combines map information from various independent sources into a single map of all land covers in California.

Methods

Merging data from multiple sources required addressing differences in resolution, currency, extent, categorical detail, classification system, and consistency. These differences were resolved and a final product created through the following processes:

- **Data evaluation:** unique characteristics of disparate vegetation data were evaluated including resolution, currency, extent, categorical detail, classification system, and consistency;
- **Cross-walking:** each data source was cross-walked into the CWHR classification scheme. This process reinterprets vegetation type, size, and canopy closure labels from the source classification scheme to the CWHR scheme;
- **Data merging:** decision rules were developed to determine which sources would take precedence during the merge process; and
- **Data review:** in-house and public review of final product.

Future efforts

Updated versions of these data will be released as additional data sources become available and are merged into the FRAPVeg product. Since almost half of the Statewide habitat data comes from the LCMMP, it is estimated that at least one-fifth of the forest and range areas will be updated every year. However, this schedule also offers opportunities to input newly available data from other sources.

Ultimately, California needs a comprehensive, coordinated strategy to map land cover and wildlife habitat across the State to common standards. That is the focus of a Memorandum of Understanding for Cooperative Vegetation and Habitat Mapping and Classification, which has been signed by 11 State and federal agencies (California Environmental Resources Evaluation System, 2000). The success of this effort will determine if eventually more efficient use of limited mapping resources can be made.

Additional information

For a more detailed explanation of methods and data sources used to create this Statewide, multi-source habitat data layer, see the online document FRAP Multi-Source Vegetation.

Forest Inventory and Analysis

The U.S. Forest Service, Pacific Northwest Experiment Station (PNW), Pacific Resource Inventory Monitoring and Evaluation Program (PRIME) publish information on forest statistics known as the Forest Inventory and Analysis (FIA). The FIA program inventories the extent and condition of forest resources on a 10-year cycle. The program provides forest inventory data across all ownerships in Alaska, California, Hawaii, Oregon, and Washington. FIA maintains a permanent grid of field plots across the Pacific Coast states. The program is transforming from periodic re-measurements conducted every 10 years to a sampling of 20 percent of all field plots per year in every state. Initial steps towards this goal include samplings of 15 percent of eastern and 10 percent of western United States plots. Maintaining the confidentiality of plot locations is a legal requirement of the program and crucial to ensuring continued access. Furthermore, data from individual plots are combined to create statistically accurate portrayals while ensuring the confidentiality of individual plots. The California Department of Forestry and Fire Protection (CDF) combines data gathered on these plots with data collected by analyzing aerial photographs, satellite imagery, and map layers within GIS (Table 1).

Table 1. FIA plot types

FIA phases	Variables collected
Phase 1 Plots (P1)	Remote sensing phase aimed at classifying the land into forest and non-forest and taking spatial measurements such as fragmentation, urbanization, and distance variables
Phase 2 Plots (P2)	Set of field sample locations distributed across the landscape with approximately one sample location plot every 6,000 acres
Phase 3 Plots (P3)	Subset of the phase two plots that are visited during the growing season in order to collect an extended suite of ecological data

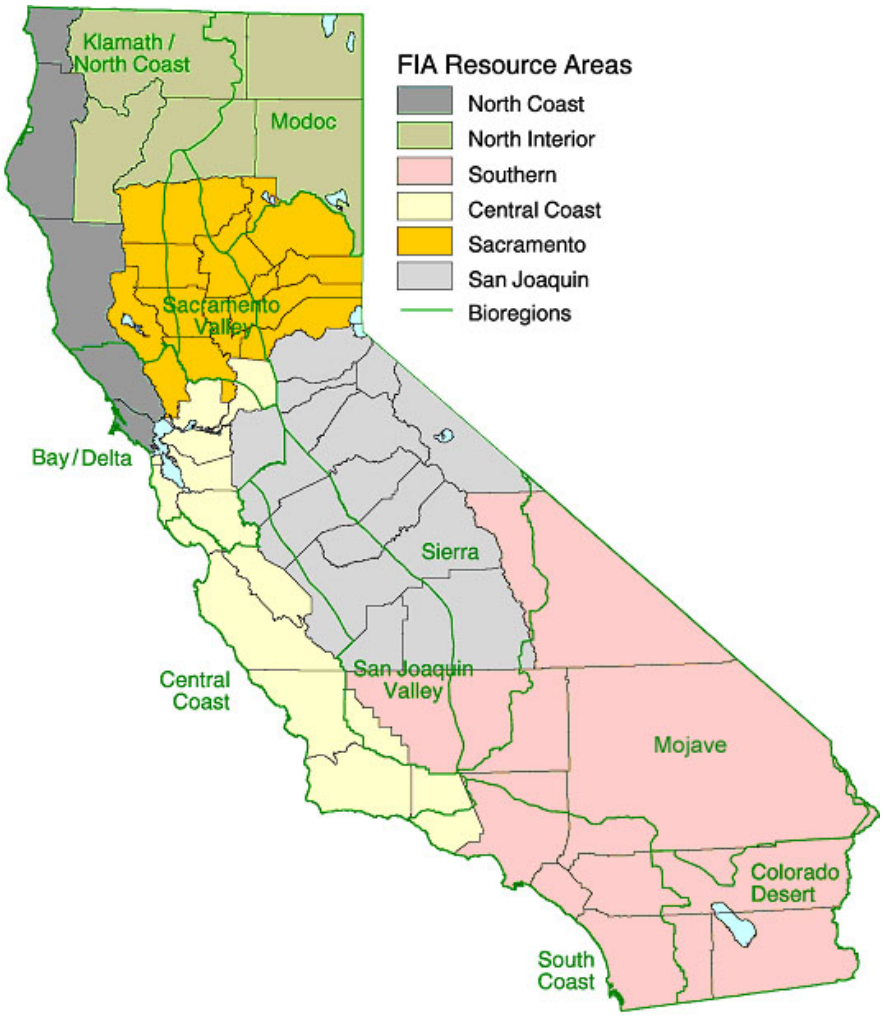
After a plot is established on the ground, field crews return to re-measure trees, understory vegetation, and other resource attributes. Plot measurements include:

- aspect, slope, land forms;
- down woody debris—down dead wood;
- plot coordinates;
- snags (standing dead)—size, use, and decay;
- stand history;
- trees—growth, health, mortality, and harvest;
- understory vegetation—shrub, forbs, and grass species;
- crown condition (P3 plots only);
- ozone injury (P3 plots only);
- lichens (P3 plots only)—diversity and abundance;
- soil condition (P3 plots only);

FIA for California

In California, FIA statistics are collected and reported for six regions called resource areas. These include North Coast, Central Coast, North Interior, Sacramento, and San Joaquin/Southern (Figure 1). FIA classifies the forest land base into categories that describe capability and availability for timber production.

Figure 1. FIA resource areas and county boundaries



Source: U.S. Forest Service (USFS), 2002

FIA defines classes based on productive capacity and administrative status, often removing land from commodity production. Forest land totals will differ from the FRAP estimates due to inclusion of non-stocked lands, which include recently harvested areas and productive shrub lands that are currently not forested. FIA groups forest land into the following four categories:

- **Timberland:** Forest land capable of growing 20 cubic feet or more of industrial wood per acre per year (mean increment at culmination in fully stocked, natural stands). Timberland is not in a reserved status through removal of the area from timber utilization by statute, ordinance, or administrative order and is not in a withdrawn status pending consideration for reserved. Timberlands account for 42 percent (16.6 million acres) of the forest lands in California. These lands correspond closely to lands that can be viably managed for sustainable timber production. Nearly all forest acres owned by industry meet this definition. Roughly one quarter of non-industrial private forest land (NIPF) meets these criteria. The percentage is low due to the large acreage of private hardwood woodlands.

- **Reserved and withdrawn timberland:** Forest land capable of growing 20 cubic feet or more of industrial wood per acre per year (mean annual increment at culmination in fully stocked, natural stands). Reserved timberland has been dedicated to non-commodity use through statute, ordinance, or administrative order. Examples of reserved timberland include portions of national parks, national forest wilderness areas, State and county parks, or other special areas where commodity production activities are incompatible with agency missions. Reserved timberland covers 10 percent (3,176,000 acres) of forest land Statewide.
- **Other forest:** Forest land incapable of growing 20 cubic feet of industrial wood per acre per year (mean annual increment at culmination in fully stocked, natural stands) due to adverse conditions. Such conditions include sterile soils, dry climate, poor drainage, sub-alpine sites, steepness, or rockiness.
- **Reserved other forest:** Forest land not capable of growing 20 cubic feet of industrial wood per acre per year and statutorily reserved from harvesting.

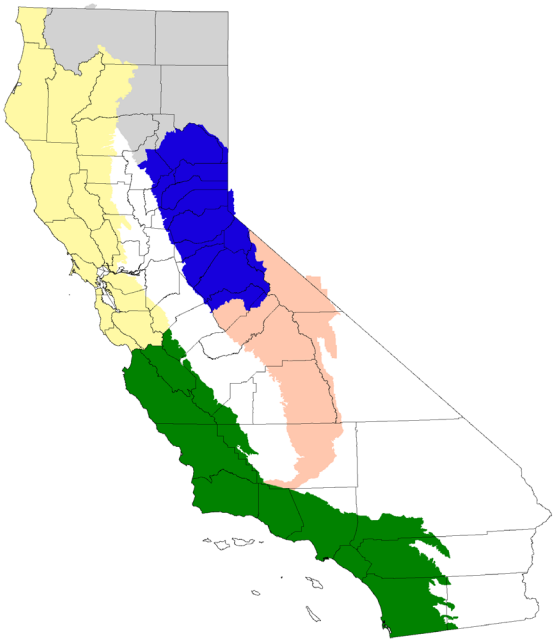
Additional information

See the online document Forest Inventory and Analysis for more information.

California Land Cover Mapping and Monitoring Program data

The LCMMP is a collaboration between FRAP and the U.S. Forest Service (USFS) to create seamless vegetation and monitoring data across most ownerships and vegetation types within California. This program uses various remotely sensed imagery sources to map land cover types and derive land cover changes across most ownerships. The State is covered in five unique project areas. One project area is completed each year, then revisited and updated every fifth year (Figure 2).

Figure 2. LCMMP project areas



Source: FRAP, 2002b

Monitoring

Monitoring land cover change occurs in one of five distinct project areas each year. Complete Statewide coverage of land cover change occurs every five years (Table 2). Analysis is complete for all project areas in the first Statewide cycle. Each project will be revisited during the next subsequent Statewide cycle.

Table 2. Monitoring dates by project area (status, January 2003)

	Cycle 1		Cycle 2		
Project area	Image dates (approx.)	Change data complete	Image dates (approx.)	Change data complete	Acres (approx.)
Southern Sierra	1990-1995	yes	1995-2001	no	10 million
Northern Sierra	1991-1996	yes	1996-2000	yes	9 million
South Coast	1992-1997	yes	1997-2002	no	17 million
North Coast	1994-1998	yes	1998-2003	no	16.5 million
Cascade Northeast	1991-1996	yes	1994-1999	yes	11.7 million

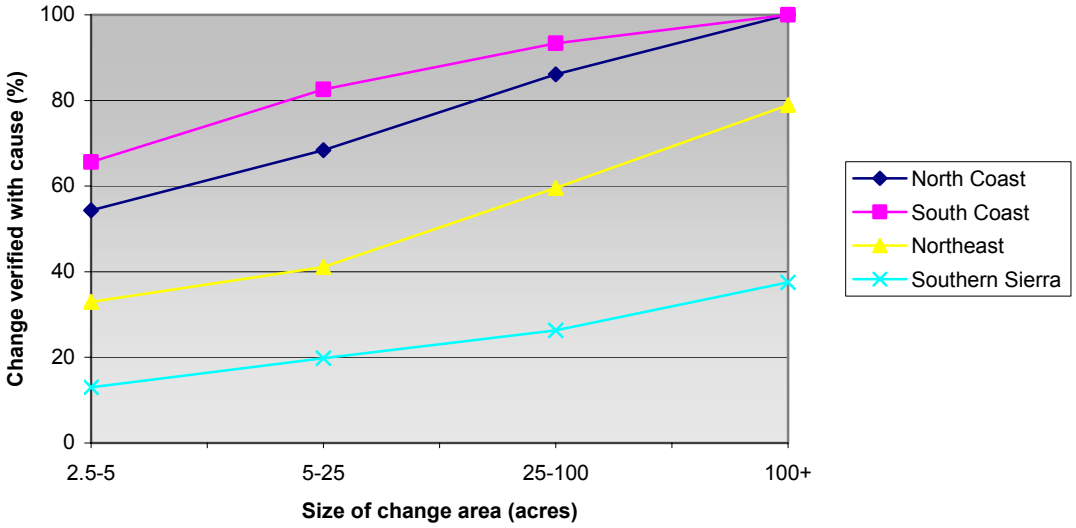
Source: FRAP, 2002b

The LCMMP uses two dates of thematic mapper imagery to detect land cover change. Change detection techniques interpret differences in spectral reflectance between image dates to produce a map depicting various levels of vegetation change. A difference in spectral reflectance (the amount of sunlight reflected from surface features to the satellite in space) between image dates indicates where change probably occurred. For hardwood and conifer canopy cover loss, change classes are broken down into three categories: minus 71 to minus 100 percent canopy cover (71 to 100 percent decrease in canopy cover), minus 41 to minus 70 percent canopy cover, and minus 16 to minus 40 percent canopy cover. For hardwood and conifer canopy cover gain, change classes are broken down into two categories: plus 16 to plus 40 percent canopy cover and plus 41 to plus 100 percent canopy cover. In the shrub/chaparral and herbaceous vegetation types, change is quantified into single decrease and increase classes of 16 percent or greater.

Once the final change map is complete, an attempt is made to verify cause on all change areas. Causes of change are verified through GIS overlay analysis, fieldwork, photo interpretation, and interpretation by land managers, landowners, and other stakeholders. The GIS overlay analysis uses the CDF forest practices database, USFS stand record system, and Statewide fire history layer to attribute changes caused by harvests, regeneration, and wildfires. USFS resource managers interpret change maps by applying local knowledge and fieldwork to identify sources of change on USFS lands. Similarly, University of California Integrated Hardwood Range Management Program personnel consult private landowners to verify causes of change in hardwood rangelands. Despite all these efforts, complete cause verification is not possible due to the large number of change areas, insufficient information, and inaccessible lands.

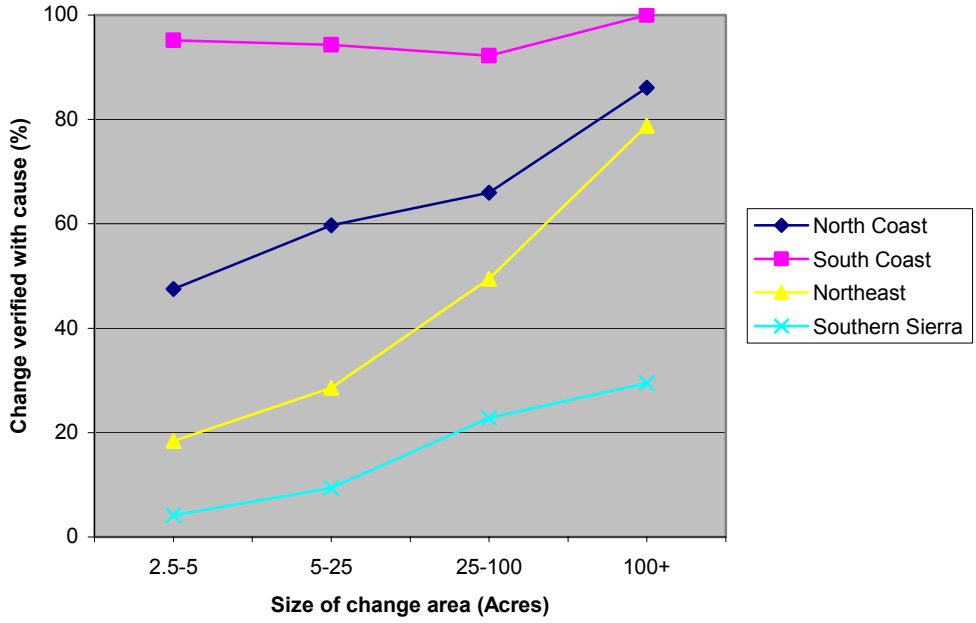
Larger change areas (greater than 25 acres) are more readily attributed compared to ones (2.5 to 10 acres) (Figures 3 and 4). The North Coast and South Coast LCMMP project areas have at least 50 percent verified in all change area sizes, while in the northeast everything over 25 acres is at least 50 percent. The southern Sierra has low percentages, but it was the first area and methods were being evaluated.

Figure 3. Percentage area of hardwood change attributed with cause by change area



Source: FRAP, 2002b

Figure 4. Percentage area of conifer change attributed with cause by change area



Source: FRAP, 2002b

Interpreting land cover change results

Multiple change classes are created to represent different levels of canopy cover change. Vegetation canopy cover increases and decreases represent areas of vegetation that underwent some form of change between image dates. For forests and rangelands, an increase or decrease relates to changes in canopy cover. The little or no change class indicates that change within the existing vegetation is either nonexistent or too subtle for the methods to detect.

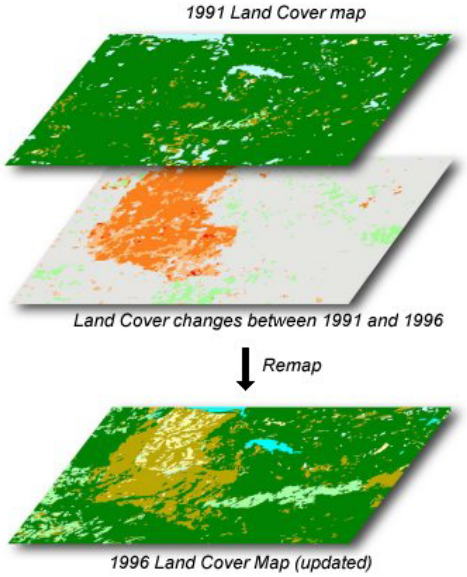
A clear distinction must be made between results listed as vegetation increases versus decreases. Vegetation cover increase, particularly a small increase, does not necessarily represent a gain in canopy or extent of a specific vegetation type. In some cases, the increase represents understory re-growth, seasonal variation, or succession following a disturbance. The hardwood and shrub/chaparral types with low canopy cover and slow growth rates are particularly sensitive to this phenomenon due to the presence of understory grasses and forbs within these types. Vegetation decreases, however are quite indicative of substantial changes in the canopy. Essentially all canopy reductions, whether from clear cuts, selective harvests, or wildfires, are captured by the change data, while only the first decade of re-growth after a disturbance is captured when recorded as an increase. Because the change data best reflects vegetation decreases, particularly when describing changes to tree vegetation, most monitoring results included here focus on decreases in canopy cover.

Vegetation mapping

Land cover data are captured using mostly automated, systematic procedures that can efficiently and consistently map large areas at a low cost. The program utilizes image classification, GIS modeling, and on-the-ground verification to generate data that describe the condition and extent of various land cover types. Remotely-sensed data sources include Landsat thematic mapper satellite imagery, Indian Remote Sensing satellite imagery, SPOT (Systeme Pour L'Observation de la Terra) satellite imagery, digital orthophoto quads, and high-resolution aerial photographs. GIS models based on slope, aspect, and elevation are developed to assign specific vegetation types (e.g. Redwood, Blue Oak, Montane, Chaparral, etc.) to basic land cover life forms (e.g. conifer, hardwood, shrub, grass, barren, urban, agriculture, water). In some cases, soils and precipitation data are employed in the vegetation modeling process. Extensive fieldwork is conducted to develop GIS-based model rules that are developed and applied on the basis of natural regions. A natural region is an area that exhibits similar vegetation patterns and for which one set of model rules can be applied. Natural regions also serve as the processing areas for data development. After image classification and GIS processing, experienced field technicians use photo interpretation and fieldwork to adjust model rules and edit automated outputs. After model rules are adjusted, the layer is brought into vector format and hand edited using digital orthophoto quads and high-resolution aerial photos as a backdrop.

Initially, baseline map products are developed for each of the five LCMMP project areas (Figure 2) and updated each fifth year using changed areas identified under the monitoring component (Figure 5). This process maintains current data in a very efficient and cost-effective manner, since it only requires re-mapping in areas that have changed.

Figure 5. Vegetation updates



Source: FRAP, 2002b

The land cover mapping products include GIS layers of cover type, vegetation type, tree size, and tree density with a minimum map unit of 2.5 acres. Vegetation labels provide specific forest community types. These community types may consist of a single dominant tree species or an alliance of several species. Vegetation labels are developed based on the CALVEG classification, which is a hierarchical vegetation classification developed by the USFS. FRAP reinterprets CALVEG vegetation types into habitat types using the CWHR system. Tree size and tree canopy closure layers are created using a combination of image classification, modeling, and editing. Size labels describe dominant tree size in a stand, and density labels describe canopy cover in 10 percent class breaks.

Additional information

LCMMP reports, data, and maps can be found on the FRAP web site at California Land Cover Mapping and Monitoring Program.

Fire related data

California Fire Plan

The California Fire Plan provides a GIS-based framework for systematically assessing existing levels of wildland protection services, identifying high-risk and high-value areas that are potential locations for costly and disastrous wildfires, ranking these areas for priority needs, and prescribing future efforts to reduce costs and losses. The Fire Plan analysis framework consists of the following four assessments:

- **Fuels:** Areas ranked based on potential fire behavior;
- **Weather:** Areas ranked based on likelihood of severe fire weather;

- **Assets at Risk:** Areas ranked based on up to 15 different assets identified; and
- **Level of Service:** Areas ranked based on the number of initial attack failures.

Each assessment is ranked and then overlaid in GIS to identify high-risk, high-value areas. The goal is to prioritize treatment areas given limited financial and staff resources. CDF developed the Fire Plan assessment framework to help identify areas in which it is most cost-effective to increase the level of wildland fire protection services. The purpose of this methodology is to significantly decrease future wildfire costs and losses in high-risk, high-value areas.

Fire history

As part of the California Fire Plan, FRAP compiled fire perimeter maps and established an on-going fire perimeter data capture process in order to update vegetative fuel rank maps. In an interagency effort, FRAP compiled CDF fires 300 acres and greater in size and USFS fires 10 acres and greater into a Statewide spatial database. Data attributes maintained in this layer include the date and name of the incident, lead agency, the incident number for linking to other fire-related databases, cause of fire, and fire size. The process will integrate additional fire perimeter databases from the U.S. Bureau of Land Management and the National Park Service as they become available.

FRAP will produce an annual Statewide fire perimeter GIS data layer by combining digitized fire perimeters from CDF and the USFS. The long-range goal for maintenance of fire perimeter data will decentralize the data capture process to the individual fire station level. Immediately following a fire event, local fire station personnel will map fires into the database. This process will be facilitated by a user-friendly computer application that connects the local field user to a client-server database in Sacramento. CDF implemented a similar process, the Emergency Activity Reporting System, for non-spatial data in 1989.

The fire perimeter database developed by CDF and USFS represents the most complete digital record of fire perimeters in California. However, it is still incomplete in many respects. Users of the fire perimeter database must exercise caution to avoid inaccurate or erroneous conclusions.

Fire threat

Combining fire frequency and fire behavior indices, FRAP developed a single assessment metric for fire called “Fire Threat.” Fire frequency and potential fire behavior are each classified into one of three rankings: moderate, high, and very high. The two component scores were summed to develop a fire threat index ranging from two to six. This threat index is then grouped into its own three-level classification. Threat scores of six (e.g., having both the highest frequency class and highest fire behavior rank) received an extreme fire threat rank. Scores of four or five received a very high threat rank. A score of three received a high threat rank. Lastly, a score of one or two received a moderate threat rank (Table 3). Areas that did not support wildland fuels (e.g., open water, agriculture lands, etc.) were omitted from the calculation of fire threat. Areas with a zero value fire rotation score but still possessing a potential fire behavior rank were included. The reason for this inclusion was that many areas were not calculated due to historic fire data deficiencies, precluding the ability to determine fire rotation.

Table 3. Fire threat matrix based on fire rotation class and potential fire behavior rank

	Potential fire behavior		
Rotation	1 (Moderate)	2 (High)	3 (Very High)
0 or 1 (Moderate)	1 or 2 (Moderate)	3 (High)	4 (Very High)
2 (High)	3 (High)	4 (Very High)	5 (Very High)
3 (Very High)	4 (Very High)	5 (Very High)	6 (Extreme)

Source: FRAP, 2002c

Fire condition classification

As part of the ongoing National Fire Plan strategy to protect ecosystems from degradation, loss of diversity, and possible loss or conversion, a classification system has been developed to assess fire-related risk to basic ecological health. A coarse-scale assessment of this measure, termed "Condition Class," was conducted for the lower 48 states in support of the initial policy development for the National Fire Plan (Hardy et al., 2001; Schmidt et al., 2002; Hardy and Bunnell, 1999). The process is continuing to be refined to better meet the needs of local and regional planning and implementation. As a result, reduced risks to ecosystem health and stability can be realized while still being conducted under a centralized and consistent approach nationwide (Hann, 2002).

FRAP has developed ecosystem risk assessment that is conceptually consistent, but utilizes California-specific data to describe ecosystems and fire-related components already constructed for other purposes. This method defines and qualitatively describes basic fire-related risks to ecosystems. Condition class measures are assigned comparing natural fire regime and current fire conditions. Fire regime condition classes were defined as the "relative risk of losing key components that define an ecosystem (Hardy et al., 2001). The conceptual basis is that for fire-adapted ecosystems, much of their ecological structure and processes are driven by fire. Departure from natural fire regimes creates instability and an increase in risk to key components of that particular ecosystem. The method utilized here follows the existing condition class definitions being used at the national level (Hann, 2002), where lands are assigned one of three condition class levels indicating the relative risk to the ecosystem (Table 4).

Table 4. Condition class definitions used in Ecosystem Risk Assessment

Class	NRV or HRV Departure	Description
Condition Class 1	None, Minimal, Low	Vegetation composition, structure, and fuels are similar to those of the historic regime and do not pre-dispose the system to risk of loss of key ecosystem components. Wildland fires are characteristic of the historical fire regime behavior, severity, and patterns. Disturbance agents, native species' habitats, and hydrologic functions are within the historical range of variability. Smoke production potential is low in volume.
Condition Class 2	Moderate	Vegetation composition, structure, and fuels have moderate departure from the historic regime and predispose the system to risk of loss of key ecosystem components. Wildland fires are moderately uncharacteristic compared to the historical fire regime behaviors, severity, and patterns. Disturbance agents, native species' habitats, and hydrologic functions are outside the historical range of variability. Smoke production potential has increased moderately in volume and duration.
Condition Class 3	High	Vegetation composition, structure, and fuels have high departure from the historic regime and predispose the system to high risk of loss of key ecosystem components. Wildland fires are highly uncharacteristic compared to the historical fire regime behaviors, severity, and patterns. Disturbance agents, native species' habitats, and hydrologic functions are substantially outside the historical range of variability. Smoke production potential has increased with risks of high volume production of long duration.

HRV – historic range of variation; NRV – natural range of variation

Source: Hann, 2002

FRAP then assigned condition classes based on current vegetation type and structure (CWHR type and size and density) and the unique combination of expected fire frequency and potential fire behavior. In some instances the major disruption of the fire regime was related to fuel accumulation; hence, fire behavior dominated the selection of the condition class level. In other situations, changes have been largely driven by alteration of expected fire frequency, with no apparent alteration of the natural range in fuel conditions. Finally, in some cases, the logic for condition class assignment was based on both the expected frequency and fire behavior components. In all cases, specific knowledge of data limitations and classification categories was used to make the best decision possible.

Additional information

For additional information on the California Fire Plan, see the online document California Fire Plan: A Framework for Minimizing Costs and Losses from Wildland Fires. For information on the National Fire Plan, see National Fire Plan: Managing the Impact of Wildfires on the Communities and the Environment. For information on fire history, see Fire Perimeter Data.

Census and projected development

United States Census, 2000

FRAP created a Statewide census block coverage from individual county Topologically Integrated Geographic Encoding and Referencing (TIGER) files obtained from the U.S. Census Bureau in 2000. The county boundaries do not match 1:100,000 scale U.S. Geological Survey (USGS) county line work but do edge match seamlessly with each other. FRAP removed TIGER roads and streams that split census blocks into multiple polygons and detected no slivers after combining the county coverages.

The Statewide coverage was overlaid with ownership data to delineate uninhabitable areas of public ownership. Population and housing densities were then calculated based on the habitable square miles. FRAP terms this process "migrating census counts."

FRAP considered the following public ownership classes "habitable" and therefore did not exclude census counts: U.S. Bureau of Indian Affairs, U.S. Department of Defense, National Aeronautics and Space Administration, California Department of Corrections, California State University, University of California, and California National Guard. Although large portions of some of these ownerships may indeed be uninhabitable (such as U.S. Department of Defense lands), no such delineations exist and large numbers of people do reside on these lands. In contrast, although people do reside in National Parks (such as Yosemite Valley), these numbers are small and the vast majority of National Park lands are uninhabited.

Attributes in the Census 2000 coverage include 100 percent enumerated housing and population count, density per square mile, urban/rural, urbanized area, place name with related information, and water designation. A block group coverage was also created to allow Summary Tape File 1 data tables and Summary Tape File 3A data tables to be linked to this coverage.

United States Census, 1990

The Teale Data Center created a statewide census block coverage from individual 1990 county census TIGER files provided by the U. S. Census Bureau. These census TIGER files used county boundaries that did not always match USGS county boundaries, which sometimes overlapped adjacent counties. FRAP cleaned these slivers arbitrarily, and therefore the county boundaries may not match boundaries of the original TIGER files. This was done to conform the census coverage with other county-based FRAP coverages.

Additionally, FRAP created a block group coverage from the statewide census block coverage to link data from Summary Tape File 3A. This allowed the calculation of historical housing counts by decade from the Summary Tape File 3A attribute of "year structure built." See the online document Home Page of the U.S. Census Bureau for more information.

Projected development

To effectively assess land use trends and potential responses, it is useful to have a systematic approach towards projecting the land use impacts of population growth. FRAP has developed a method for mapping historical development and predicting future development trends within a common framework across all lands in California over the period 1940-2040. The primary purpose is to produce accurate estimates within the acreage projected to attain at least a dispersed level of residential land use.

Methods

The mapping of development over the period 1940-1990 is based on "year structure built" data from the 1990 U.S. Census Bureau for block group parts. The map shows housing density by decade. Before calculating housing density, the spatial accuracy of the census housing counts are improved by reallocating houses off of non-habitable public lands onto lands in private ownership. Next, the map is overlaid on a circa-1940 vegetation base map (1945 Weislander map). The Weislander vegetation map

shows the location of broad vegetation types based on field mapping during the late 1930s and early 1940s.

To project housing development into the future, the map depicting the historical progression of development is recast into a uniform grid of approximately 9.6 square mile cells. Furthermore, decade-by-decade housing density is computed to the year 2040 based on allocations of county population projections made by the California Department of Finance. These projections are first converted to housing projections using the county's 1990 ratio of houses to people. The projections are then allocated to cells according to each cell's proportion of the total growth in county housing during the 1980-1990 period. The "share of growth" method reflects recent growth patterns (Pittenger, 1976; White, 1954; Smith et al., 2001). This map is also overlaid onto the historical Weislander vegetation map.

Additional information

For a more detailed description of data, methods, and results see the online document Development and Vegetation Trends.

The management landscape

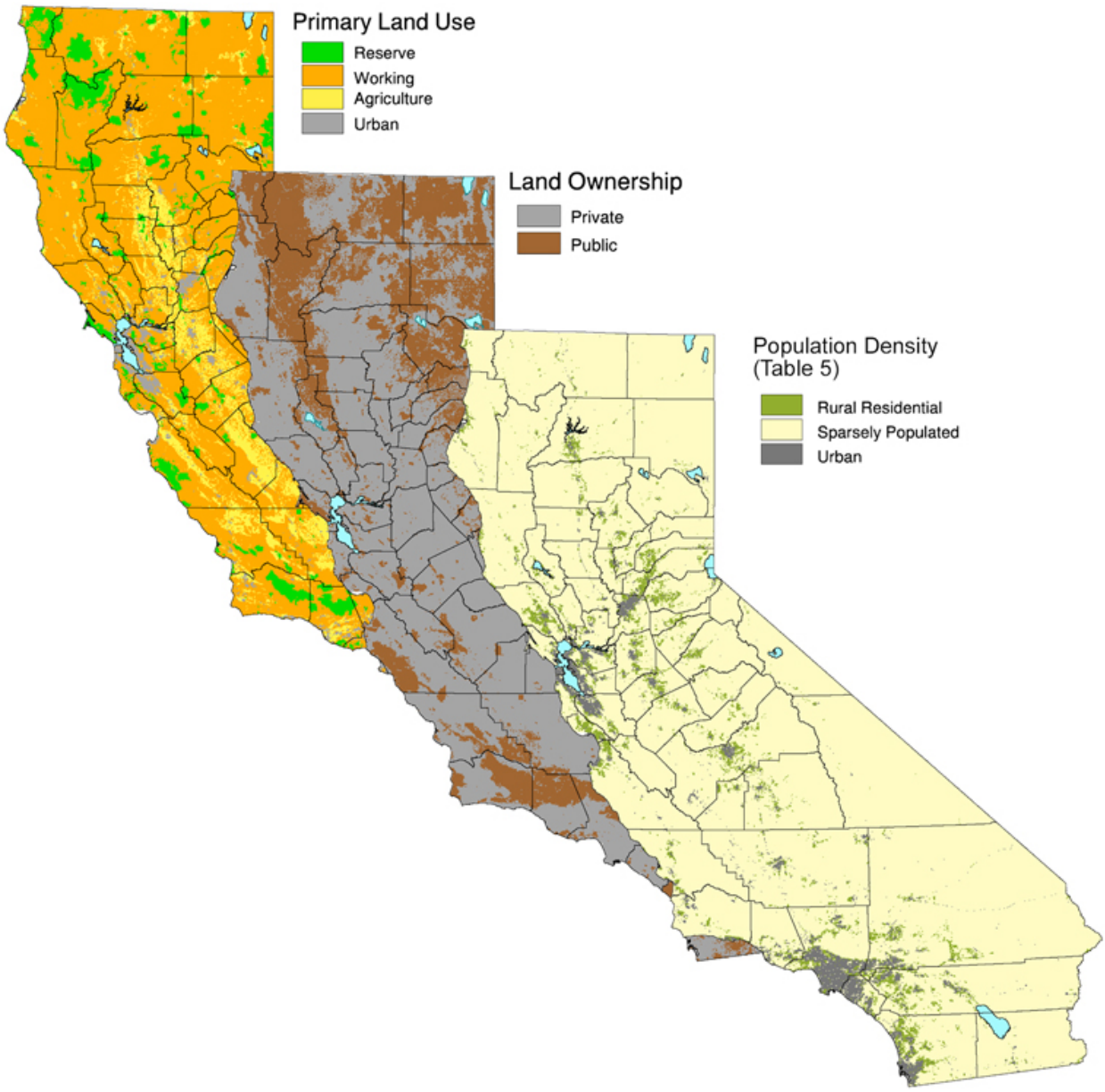
The Management Landscape is a conceptual framework that describes how land is used and managed. Three major components comprise the Management Landscape in California: primary land use, ownership, and population density (Figure 6).

Primary land use

Primary land use is the applied or intended purpose for the land as defined by the owner and can be classified into four broad categories:

- **Reserve:** lands permanently managed with statutory designations such as National Parks and wilderness areas. Commodity production prohibited or greatly restricted. These lands are equivalent to the Gap Analysis Program analysis of California Management Status classes 1 and 2 (Davis et al., 1998).
- **Working:** lands primarily managed for commodity production and/or services but with consideration for ecosystem integrity. Examples include timber production forests (both private and public), ranches, and regional parks that utilize grazing to control vegetation.
- **Agriculture:** irrigated lands managed for production of food or fiber with only modest consideration for ecological concerns. Examples include cotton fields, rice paddies, or vineyards.
- **Urban:** lands having commercial use or housing densities of one unit per acre or greater. Subsequently, these areas have little ecological value.

Figure 6. Management Landscape components



Agriculture: irrigated lands managed for production of food or fiber; examples include cotton fields, rice paddies, or vineyards
Urban: lands having commercial use or housing densities of one unit per acre or greater

Source: FRAP, 2002a

Land Ownership

Ownership is defined as the legal property owner and decision-maker for the land. Ownership is either private or public.

Housing density

Housing density is the density of individual housing units (single family homes, individual apartments dwellings) settlement on the land. This factor represents the pressure of human development on the landscape and is broken down into three broad density classes:

- **Urban:** lands having commercial use or densities of one housing unit or more per acre.
- **Rural Residential:** density of one housing unit per 20 acres up to one housing unit per acre.
- **Sparsely Populated:** density of less than one housing unit per 20 acres.

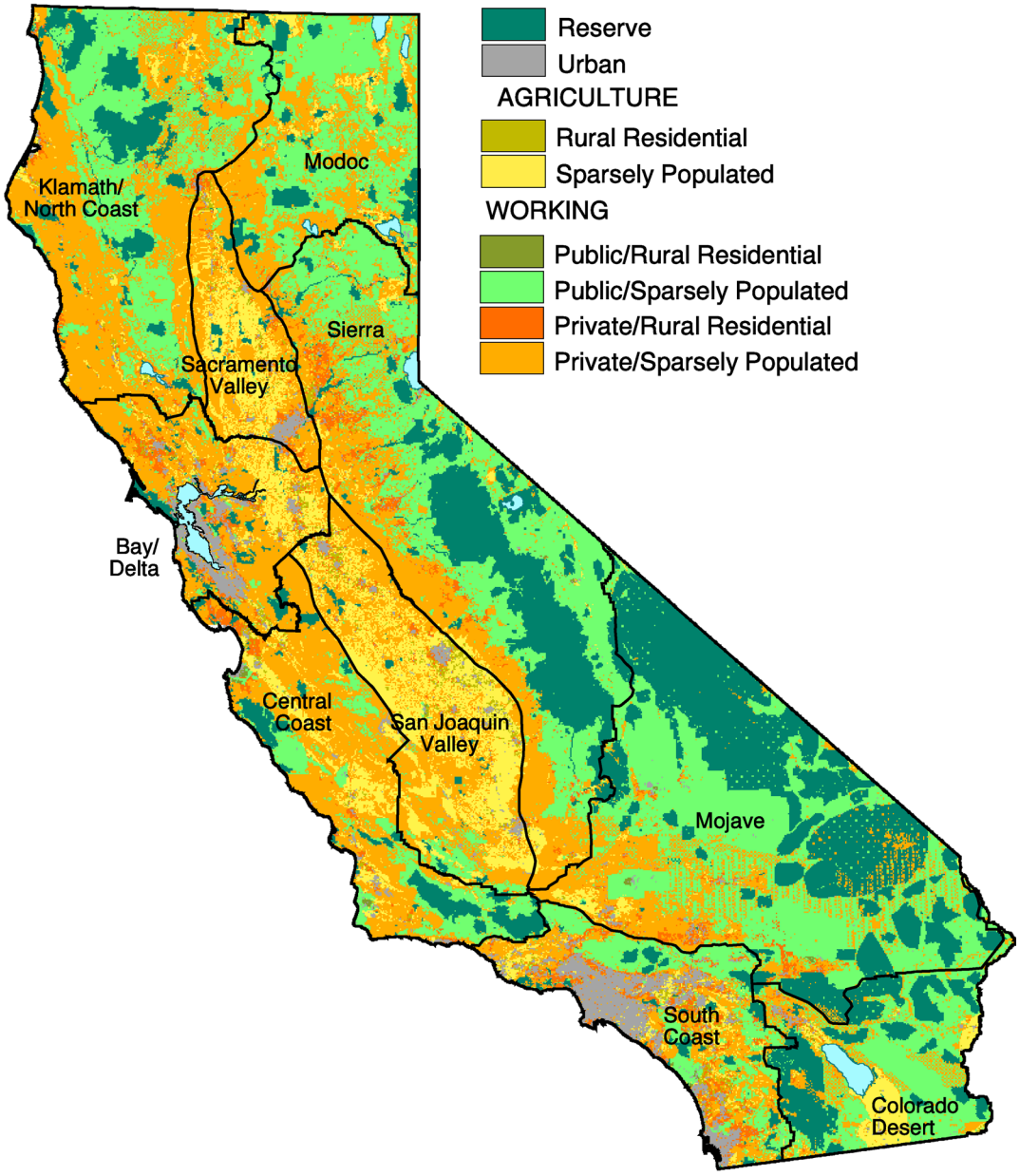
These three components (Primary Land Use, Ownership, and Population Density) combine into a single, although visually complex, map called the Management Landscape (Figure 7). The Management Landscape map is the basis for much of the FRAP Assessment and contains eight management classes: Reserve, Urban, Agriculture (Rural Residential and Sparsely Populated), Working (Public/Rural Residential, Public/Sparsely Populated, Private/Rural Residential, Private/Sparsely Populated) (Table 5).

Table 5. Management Landscape class profile, all land covers, statewide

Management classifications	Area (millions of acres)	Management emphasis
Reserve	20	Consistent with these designations: wilderness, wild and scenic, national parks, national monuments. Commodity production prohibited or greatly restricted.
Working/Public/Sparsely Populated	31	Lands under public administration with management consistent with agency mandate. Commodity production allowable. Housing density less than 1 unit per 20 acres.
Working/Private/Sparsely Populated	33	Lands under private ownership with management and commodity production consistent with governmental regulations. Housing density less than 1 unit per 20 acres.
Working/Public/Rural Residential	<1	Lands under public administration with management consistent with agency mandate. Incurs complexities of surrounding people and structures. Housing density of one or more units per 20 acres and less than 1 unit per acre.
Working/Private/Rural Residential	3	Lands under private ownership with management and commodity production consistent with governmental regulations but more complex due to surrounding people and structures. Housing density of one or more units per 20 acres and less than 1 unit per acre. Often readily available for conversion to more intensive uses.
Agriculture/Sparsely Populated	10	Fully dedicated to irrigated agriculture. Housing density less than 1 unit per 20 acres.
Agriculture/Rural Residential	1	Fully dedicated to irrigated agriculture. More complex due to surrounding people and structures. Housing density of one or more units per 20 acres and less than 1 unit per acre.
Urban	3	Dedicated to high-density residential and commercial uses. Housing density of one or more units per acre.
Total	**101**	

Source: FRAP, 2002a

Figure 7. Management Landscape



The Management Landscape map contains information from sources of varying dates. While most data used in the map is circa 1990-1999, some information is circa 1970

Source: FRAP, 2002a

California Spatial Data Information Library

The California Mapping Coordinating Committee is in the process of developing a series of GIS-related web pages to provide information on State government GIS activities, access to Statewide GIS data, and links to the larger California GIS community. This website is the California Spatial Information Library.

Starting July 1, 2001, some of California's physical and cultural geospatial information, formerly distributed by the Teale Data Center, are being distributed to the public by the California Mapping Coordinating Committee through servers at the California Environmental Resources Evaluation System (under the California Resources Agency) and National Aeronautics and Space Administration's Ames Research Center. For a more information see the online document The California Spatial Information Library.

Glossary

ArcInfo: GIS data creation, update, query, mapping, and analysis system.

BOE: California State Board of Equalization.

California Wildlife Habitat Relationship: California Wildlife Habitat Relationship is a state-of-the-art classification system for California's wildlife. CWHR contains life history, management, and habitat relationships information on 675 species of amphibians, reptiles, birds, and mammals known to occur in the State. CWHR products are available for purchase by anyone interested in understanding, conserving, and managing California's wildlife.

CALVEG: Hierarchical vegetation classification developed by the U.S. Forest Service.

CDF: California Department of Forestry and Fire Protection.

CWHR: See **California Wildlife Habitat Relationship**.

down logs: Portions of trees that have fallen to the ground that are at least 10 feet long and at least 10 inches in diameter as measured on the large end.

FIA: See **Forest Inventory and Analysis**.

forb: A broad-leaved herb other than a grass, especially one growing in a field, prairie, or meadow.

FRAP: Fire and Resource Assessment Program.

FRAPVeg: Fire and Resource Assessment Program Vegetation Habitat Classification and Mapping Project, multi-source vegetation data.

Geographic Information System: A computer based system used to store and manipulate geographical (spatial) information.

GIS: See **Geographic Information System**.

HRV: Historic range of variation.

initial attack: A pre-determined dispatch of fire engines, bulldozers, hand crews, helicopters, or air tankers based on expected firefighting conditions, such as the intensity of the fire, the physical terrain, and the assets at risk.

LCMMP: California Land Cover Mapping and Monitoring Program.

natural region: An area that exhibits similar vegetation patterns and for which one set of model rules can be applied.

NRV: Natural range of variation.

old growth forest: A subjective description of a stand or stands of forest trees that exhibits large tree sizes, relatively old age, and decay characteristics common with over–mature trees; As defined by USDA FS ecologists, specific forest structure characteristics, by forest type and site class, such as size of trees, number of trees per acre, multiple canopies, degree of decay, and size and number of snags and down woody debris.

PDF: Adobe Acrobat Portable Document Format.

snags: Standing dead trees with a minimum DBH of 10 inches and a height of 10 feet.

TIGER: Topologically Integrated Geographic Encoding and Referencing.

timberland: Forest land capable of growing 20 cubic feet or more of industrial wood/acre/year (mean increment at culmination in fully stocked, natural stands). Timberland is not in a reserved status through removal of the area from timber utilization by statute, ordinance, or administrative order and is not in a withdrawn status pending consideration for reserved.

understory: The trees and other woody species growing under a relatively continuous cover of branches and foliage formed by the overstory trees.

USFS: U.S. Forest Service.

USGS: U.S. Geological Survey.

Literature cited

California Environmental Resources Evaluation System. 2000. Memorandum of Understanding for cooperative vegetation and habitat mapping and classification. Web site accessed March 4, 2003. http://ceres.ca.gov/biodiversity/vegmou.html.

Davis, F.W., D.M. Stoms, A.D. Hollander, K.A. Thomas, P.A. Stine, D. Odion, M.I. Borchert, J.H. Thorne, M.V. Gray, R.E. Walker, K. Warner, and J. Graae. 1998. The California Gap Analysis Project – final report, June 30, 1998. Santa Barbara, CA: University of California, Santa Barbara. Web site accessed June 6, 2003. http://www.biogeog.ucsb.edu/projects/gap/gap_rep.html.

Fire and Resource Assessment Program (FRAP). 1999. Teale Data Center Government Ownership, (GOVTOWNA, 1999). Sacramento, CA.

Fire and Resource Assessment Program (FRAP). 2002a. Management Landscapes, v1.0. Sacramento, CA. Web site accessed March 5, 2003. http://frap.cdf.ca.gov/data/frapgisdata/select.asp

Fire and Resource Assessment Program (FRAP). 2002b. California Land Cover Mapping and Monitoring Program. Sacramento, CA. Web site accessed March 7, 2003. http://frap.cdf.ca.gov/projects/land_cover/.

Fire and Resource Assessment Program (FRAP). 2002c. Fuel Rank (30 m or 100 m) CDF Fuel Rank (v02_2). Sacramento, CA. http://frap.cdf.ca.gov/data/frapgisdata/select.asp

Hann, W.J. 2002. Mapping fire regime condition class: a method for watershed and project scale analysis. In: Tall Timbers Research Station. In Press. Proceedings of the Tall Timbers 22nd Fire Ecology Conference – fire in temperate, boreal, and montane ecosystems, Oct. 14-18, 2001, Alberta, CA. Tallahassee, FL.

Hardy, Colin C. and David L. Bunnell. 1999. Coarse-scale spatial data for wildland fire and fuel management. U.S. Forest Service. Web site accessed March 4, 2003. http://www.fs.fed.us/fire/fuelman/.

Hardy, C.C., K.M. Schmidt, J.P. Menakis, and R.N. Sampson. 2001. Spatial data for national fire planning and fuel management. International Journal of Wildland Fire 10(3&4):353-372.

Pittenger, D. 1976. Projecting state and local populations. Cambridge, MA: Ballinger.

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report RMRS-GTR-87. Fort Collins, CO: U.S. Forest Service.

Smith, S.K., J. Tayman, and D. Swanson. 2001. State and local population projections. New York: Kluwer Academic/Plenum Publishers.

U.S. Forest Service. 2002. Forest Inventory and Analysis. Web site accessed February 25, 2002. http://www.fs.fed.us/pnw/fia/.

White, H. 1954. Empirical study of the accuracy of selected methods of projecting state population. Journal of the American Statistical Association 49:480-498.